RELATIONSHIPS BETWEEN WILD TURKEYS AND RACCOONS IN CENTRAL MISSISSIPPI

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ABSTRACT: Reduced trapping and hunting of predators has led to concerns that increased predator densities may affect game species populations. Therefore, we investigated effects of predation on the wild turkey population on Tallahala Wildlife Management Area (TWMA), Mississippi, from 1984-94. We also determined trends in raccoon trapping and hunter harvest in Mississippi. Predation of nests (eggs), nesting hens, and poults caused a population decline on TWMA. Most (88%) nest failures were caused by predation from 1984-94; raccoons were the dominant predator. Declining raccoon hunter harvest from 1980-94 was correlated with declining hunter effort. Trapping license sales and trapping harvest also declined. On TWMA, declining hunter effort was correlated with declining raccoon harvest, reflecting the statewide trend. Further reduction of predator harvest, particularly of raccoons, may negatively impact wild turkey populations in Mississippi. Future research should investigate wild turkey/predator dynamics, effects of natural controls (e.g., disease) on predator densities, and possible trapping incentives to reduce predator densities.

Proc. East. Wildl. Damage Mgmt. Conf 7:118-129. 1997.

Declines in harvest of predators has led to their increase in most areas of North America (Hamilton and Vangilder 1992). Predation of endangered species [e.g., Mississippi sandhill crane (Grus canadensis pulla), whooping cranes (G. americana), piping plover (Charadrius melodus)] and game species (e.g., gamebirds, ungulates, and waterfowl) has increased as predator populations have increased and habitats have decreased (Hamilton and Vangilder 1992). Therefore, some management strategies have shifted to predator control. Many researchers reported that predator control was not economically nor biologically feasible in the long term (MacDonald and Jantzen 1967, Knowlton 1972, Beasom 1974b, Trautman et al. 1974, Connolly and Longhurst 1975, Guthery and Beasom 1977). However, other studies reported positive responses to predator control by gamebird (Lignon 1946, Beasom 1974a, Potts 1986, Tapper et al. 1991) and waterfowl populations (Balser et al. 1968, Duebbert and Lokemoen 1980, Greenwood et al. 1990, Hamilton and Vangilder 1992).

Predators have been found to be a limiting factor for eastern wild turkey (Meleagris gallopavo silvestris) populations (Speake 1980, Hamilton and Vangilder 1992, Miller and Leopold 1992). Primary nest predators in the Southeast include raccoons (Procyon lotor), opossums (Didelphis virginiana), and striped skunks (Mephitis mephitis). Predators which prey on adult turkeys are coyotes (Canis latrans), bobcats (Felis rufus), gray (Urocyon cinereoargeteus) and red foxes (Vulpes vulpes), feral dogs (C. familiaris), and great-horned owls (Bubo virginianus). Predation of eggs and incubating hens during the nesting season limits the wild turkey population on Tallahala Wildlife Management Area (TWMA) (Palmer et al. 1993, Miller et al. 1995). Lint et al. (1995) found that harvested gobblers and harvest/effort were useful indices of gobbler population estimates, and further concluded that gobbler harvest on TWMA was an accurate index of total wild turkey population trends on TWMA (Figure 1). Gobbler harvest and ancillary observations of hens have declined 250-350% from 1984-92 on TWMA (Hurst unpubl. data, Palmer et al. 1993), indicating a population decline. In addition to predation, Lint et al. (1995) suggested that adverse environmental conditions coupled with predation contributed to the decline of the TWMA wild turkey population. Environmental conditions can not be managed; therefore, managers should focus on controllable factors. Although control of all predators is unwarranted in most cases, control and/or management should be directed at species which have highest impacts on population growth. It has been documented that

raccoons influence recruitment of poults into the population by destroying nests (i.e., eggs) at higher frequencies than other predators (Pharris and Goetz 1980, Speake 1980, Miller et al. 1995). Raccoon depredation of poults also has been documented (Peoples et al. 1995). With decreasing fur prices and a decrease in recruitment of new trappers, raccoon harvest has decreased in Mississippi in the last decade (Steffen 1981-88, Shropshire 1990-94).

Our objectives were to determine effects of raccoon depredation on an eastern wild turkey population in Mississippi from 1981-94. Changes in raccoon populations, both state-wide and on a study area (TWMA) in central Mississippi, and their effects on wild turkey recruitment also were ascertained.

We would like to thank J. Lipe, C. Shropshire, and G. Linscombe for providing us with harvest data. Thanks also goes to P. Phalen, R. Seiss, W. Palmer, J. Lint, K. Godwin, S. Priest, T. Wilson, and D. Lowrey for help in data collection. This study was supported by the National Wild Turkey Federation (NWTF), the Mississippi Chapter of NWTF, U.S. Forest Service, Mississippi State University, and Federal Aid in Wildlife Restoration through the Mississippi Department of Wildlife, Fisheries and Parks.

STUDY AREA

TWMA was located approximately 16 km southeast of Newton, Mississippi, within the Strong River District of the Bienville National Forest and was approximately 14,410 ha in size. Mean annual temperature was 18° C, and annual precipitation averaged 152 cm (Carraway 1990). Topography was flat to gently rolling with periodic flooding (3-5 day duration) occurring along major drainages. TWMA was dominated by mature (> 50 year old) loblolly pine (Pinus taeda) stands (29%), while scattered patches of shortleaf pine (P. echinata), longleaf pine (P. palustris), and spruce pine (P. glabra) were common within these stands. Approximately 15% of the study area was in loblolly pine plantations age 1-10 years. Pine plantations averaged 19 ha (range 6-32 ha) in size and rarely exceeded 26 ha. Mature bottomland hardwood stands, primarily dominated by oak (Quercus spp.) and hickory (Carya spp.) were located along major drainages and occupied approximately 33% of the area. For a more detailed and complete list of the flora on TWMA see Carraway (1990). Silvicultural practices included clear-cutting followed by pine regeneration (95%) and seed-tree cuts (5%) leaving 2-3 trees/ha. Regeneration was by mechanical site preparation and planting or by the seed-tree method. Prescribed burning from mid-November to mid-March (most occurring in Feb-Mar) of pine stands > 12 years old was conducted on an approximate 3-5 year rotations. Pine stands were first thinned at 18-years-old and again at 35-years-old. Hardwood stands were not harvested. Minimum buffer zones (equipment limitation zone) along perennial and intermittent streams was 33 feet from the floodplain. Within this zone, no more than 10% disturbance to the soil occurred (J. R. Murphy, U.S. Forest Service, Raleigh, Miss., pers. commun.).

METHODS

Capture

Hens were captured using cannon nets or bait treated with alpha-chloralose from January-March and July-August, 1984-94 as suggested by Bailey et al. (1980). Upon capture, turkeys were separately placed in boxes, sized for wild turkeys, provided by the NWTF. Turkeys were then sexed, aged as sub-adult or adult, and marked with 2 metal, triple-lock leg bands. Turkeys also were marked with 2 patagial wing tags (Knowlton et al. 1964) and fitted "backpack-style" with an 108 g mortality sensitive radio-transmitter (Wildlife Materials Inc., Carbondale, Ill.), and then released at their capture site within 10-45 minutes after capture.

Hens were monitored 4-5 times/week using a 3-element hand-held directional Yagi antenna and a Telonics (Mesa, Ariz.) TR-2 receiver. During the nesting season, hens were monitored ≥ 2 times/day, and those found in the same location in 2

consecutive days or emitting a mortality signal were assumed to be incubating. After 9-12 days of incubation behavior, nests were approached to a distance of approximately 50 m and flagged off with surveyors tape to facilitate location after termination of incubation. During incubation, hens were located at least twice daily to determine hatching date, nest destruction/desertion, or hen mortality (Palmer et al. 1993). Nests were approached as soon as incubation stopped to determine fate. Causes of nest destruction or hen death were determined, if possible, by evidence left at nest/death sites (Davis 1959). Nests were classified as successful ($\geq$ 1 egg hatched), abandoned (eggs undisturbed), or destroyed ($\geq$ 1 egg destroyed) (Palmer et al. 1993).

Data Analysis

Raccoon harvests and man-days of effort from hunters on TWMA were obtained from 1984-94 (C. Shropshire, MDWFP, Jackson, Miss., pers. commun.). Hunter harvest and man-days on TWMA were compared to state-wide hunter harvest and man-days (Steffen 1981-88, Shropshire 1990-94). Trapping harvest, total harvest from hunters and trappers, raccoon fur prices, and trapping license sales from 1981-94 also were acquired (Hamrick et al. 1986, Lipe et al. 1990). Wild turkey nest success on TWMA from 1984-94 (Miller et al. 1995) and catch/unit effort of raccoons from 1990-94 (Leopold unpubl. data) was determined. Correlation analyses (SAS Institute Inc. 1990) were performed (Table 1) to examine raccoon population trends in Mississippi and on TWMA, and success of nesting turkey hens on TWMA.

RESULTS

Significant correlations existed between trapping license sales and raccoon harvests by trappers in Mississippi from 1981-94 ($R^2 = 0.912$, $P = 0.0001$, $n = 14$) (Figure 2a), hunter harvest of raccoons and man-days hunting raccoons in Mississippi from 1981-94 (1989 data unavailable) ($R^2 = 0.804$, $P = 0.0009$, $n = 13$) (Figure 2b), and hunter harvest of raccoons and man-days hunting raccoons on TWMA from 1983-93 ($R^2 = 0.894$, $P = 0.0002$, $n = 11$) (Figure 2c). Additionally, significant correlations also were found between trapping license sales and fur prices of raccoons in Mississippi from 1981-1989 ($R^2 = 0.624$, $P = 0.0726$, $n = 9$) (Figure 2d) and success of turkey nests and raccoon captures/100 trap nights on TWMA from 1990-94 ($R^2 = 0.813$, $P = 0.0946$, $n = 5$) (Figure 2e). Significant correlations did not exist between raccoon harvest on TWMA and state-wide raccoon harvest by hunters from 1983-93 (1989 data unavailable) ($R^2 = 0.127$, $P = 0.728$, $n = 10$) (Figure 2f) and success of turkey nests and number of raccoons harvested by hunters on TWMA from 1984-93 ($R^2 = 0.337$, $P = 0.342$, $n = 10$) (Figure 2g). Similarly, significant correlations did not exist between raccoon hunter harvest/man-days effort state-wide and years ($R^2 = -0.327$, $P = 0.276$, $n = 13$) (Figure 2h), raccoon hunter harvest/man-days effort on TWMA and years ($R^2 = 0.062$, $P = 0.857$, $n = 11$) (Figure 2h), and raccoon hunter harvest/man-days effort state-wide and raccoon hunter harvest/man-days effort on TWMA ($R^2 = -0.027$, $P = 0.941$, $n = 10$) (Figure 2h).

DISCUSSION

Trapping license sales were directly correlated with number of raccoons harvested by trappers. This is a declining trend, and with pressure from animal rights groups, it does not appear that there will be much recruitment to sport trapping. Thus, raccoon harvest by trappers will continue to decline. Hunter harvest of raccoons also was correlated, both state-wide and on TWMA, to man-days hunting raccoons in Mississippi. Similar to trapping, hunter harvest of raccoons is a declining trend and like trapping trends, no improvement is likely. However, because trapping license sales were correlated to fur prices of raccoons, if markets open up that increase sales of raccoons and increase raccoon fur price, trends may be reversed. These markets also are affected by the animal rights movement and how society perceives harvesting of wild animals.

Wild turkey hen nest success was correlated with raccoon captures/100 trap nights on TWMA. Oddly, if raccoons were detrimental to nest success, this should have been a negative correlation. Data collected from 1990-92 may not have been as accurate as that from 1993 and 1994, as trap nights from 1990-92 may not have all been tabulated due to 3 concurrent projects. It has been suggested that trapped animals become "trap-shy" (Eberhardt 1969) and are more cautious of entering traps and areas where they were captured when associated with grievance. On TWMA, trap set locations and baits used for capture were similar from year to year. Consistent trap placement each year may have made raccoons wary of our traps and fewer were captured, therefore, capture/trap nights may not accurately reflect population size. Traps were primarily placed along roads in the upland sites, whereas raccoons prefer bottomland hardwoods on TWMA (Priest 1995), which also may have affected capture. Scent stations have been used for population indices on raccoons (Conner et al. 1983, Hamilton and Vangilder 1992) and are probably better at determining population trends than are capture/trap night.

Raccoon harvest by hunters on TWMA was not correlated to hunter harvest state-wide. Harvest state-wide fluctuated less than on TWMA, which appear to have a 5 year cycle. Inconsistent harvesting may have led to an increased or stable raccoon population on TWMA, suggesting that the raccoon population was not effected by sporadically high harvests. Although nest success on TWMA was not correlated to number of raccoons harvested by hunters on our study area, harvest was cyclic on TWMA as compared to the rest of Mississippi. Other factors (i.e., weather, disease) may have been confounded with predation to influence success of wild turkey nests on TWMA.

Harvest by hunters was divided by man-days of effort to determine if raccoon harvest changed with respect to time both state-wide and on TWMA. Neither state-wide nor TWMA raccoon harvest/man-day of effort was correlated to year. This suggests that there were not fewer raccoons to harvest, instead there were fewer individuals harvesting raccoons. Therefore, if hunters were harvesting fewer raccoons and habitat was available to support a larger raccoon population, then populations either have remained stable or they are increasing. Similar to raccoon harvests, harvest/man-day of effort on TWMA and state-wide were not correlated. As explained, these 5 year cycles observed in harvesting raccoons on TWMA may not affect the raccoon population on TWMA and may increase reproductive output by raccoons the year after a substantial harvest (Gehrt and Fox 1989).

MANAGEMENT IMPLICATIONS

It has been suggested that juxtaposition of roads and bottomland hardwoods have increased turkey nest depredation by raccoons and other predators on TWMA (Miller et al. 1995). Therefore, future management should focus on habitat manipulation (e.g., burning, increase or decrease edge, size of stands) instead of predator control. Although predator control may be effective for a short period, it is not cost effective and is less accepted as a management tool by society. Because of low incentives for trappers and fur hunters, most of these sportsmen continue their practice because of aesthetics and not economic benefits. Incentives for trappers and hunters may help in reducing local predator populations and should be considered in addition to other management solutions. Finally, educating urban society of advantages provided by hunting and trapping, may not only benefit game populations but increase public understanding of wildlife issues and the importance of management rendered by state and federal agencies. Additional research should focus on relationships of both environmental conditions and predation on nesting wild turkeys, influence of other predators on wild turkeys during all life stages, and effects of natural diseases (e.g., distemper) on predator populations.

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Table 1. Correlation analyses performed.

Variable 1	Variable 2	Years
Raccoon harvest by trappers in Mississippi	Trapping license sales in Mississippi	1981-91
Raccoon harvest by hunters state-wide	Man-days hunted state-wide	1981-94 (excluding 1989)
Raccoon harvest by hunters on TWMA	Man-days hunted on TWMA	1983-93
Average raccoon fur price in Mississippi	Trapping license sales in Mississippi	1981-89
Wild turkey hen nest success on TWMA	Raccoon capture/100 trap nights on TWMA	1990-94
Raccoon harvest by hunters on TWMA	Raccoon hunter harvest state-wide	1983-93 (excluding 1989)
Raccoon harvest by hunters on TWMA	Wild turkey hen nest success on TWMA	1984-93
Raccoon hunter harvest/man-days effort state-wide	Raccoon hunter harvest/man-days effort on TWMA	1983-93 (excluding 1989)
Raccoon hunter harvest/man-days effort state-wide	Year	1981-94 (excluding 1989)
Raccoon hunter harvest/man-days effort on TWMA	Year	1983-93

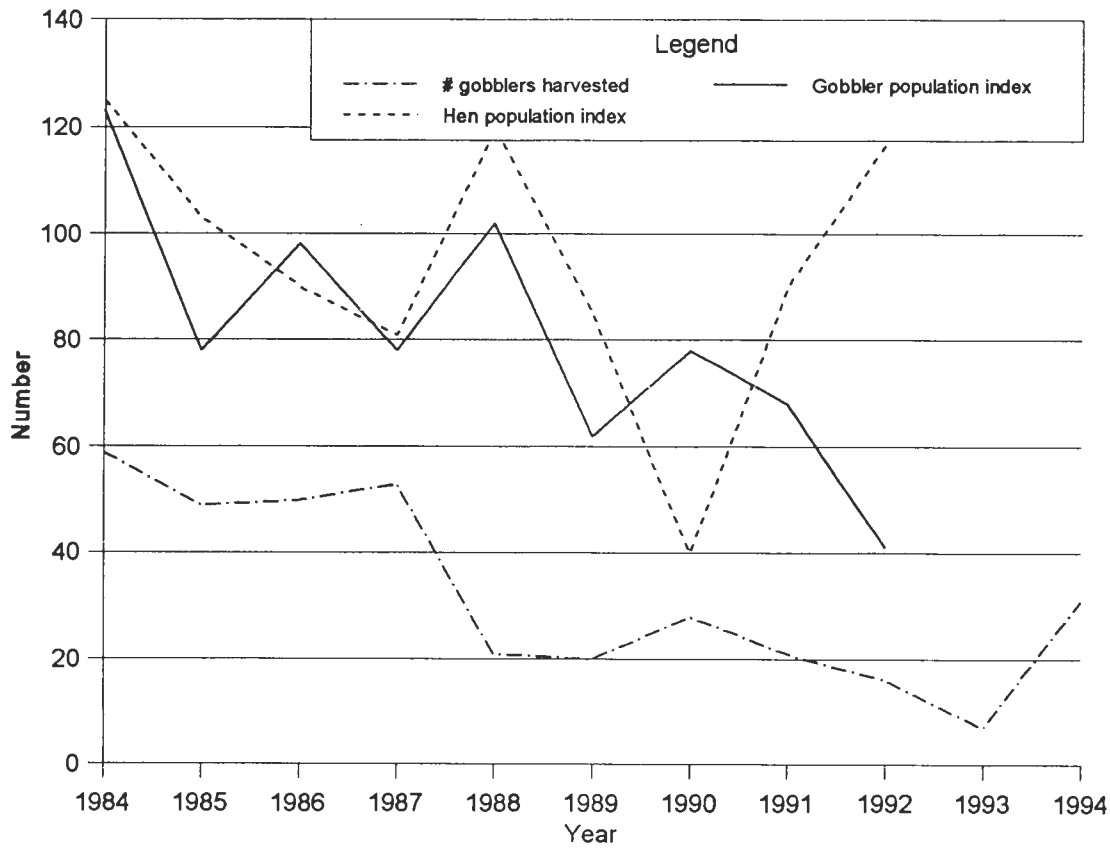
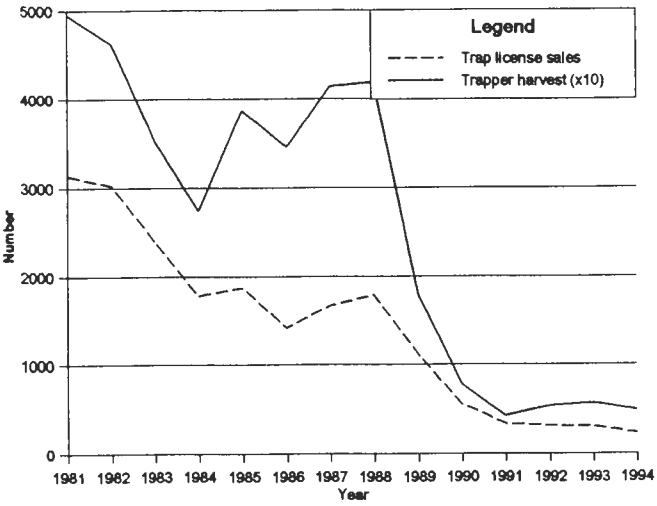


Figure 1. Number of gobblers harvested, 1984-94, and gobbler and hen population indices, 1984-92, for Tallahala Wildlife Management Area, Mississippi.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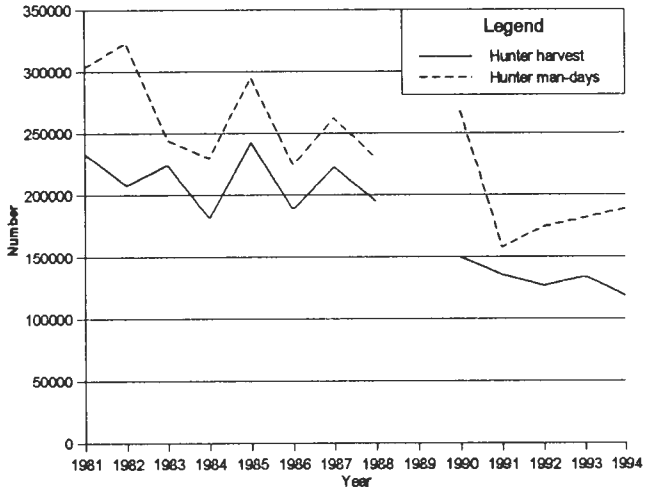
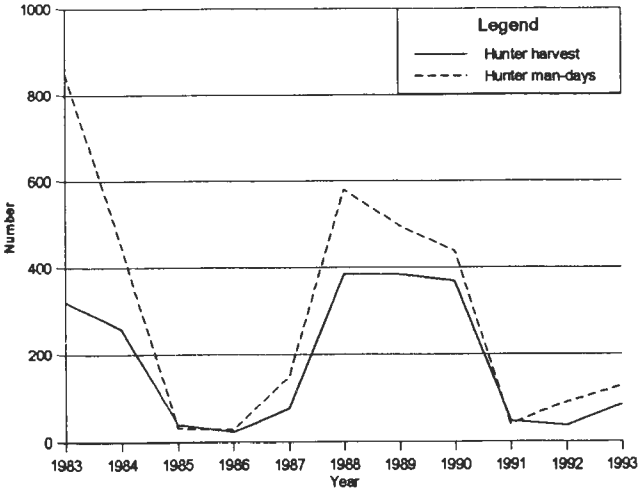
Trap license sales
Trapper harvest (x10)
Number
Year
5000
4000
3000
2000
1000
0
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994


Legend
Hunter harvest
Hunter man-days
Number
Year
350000
300000
250000
200000
150000
100000
50000
0
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994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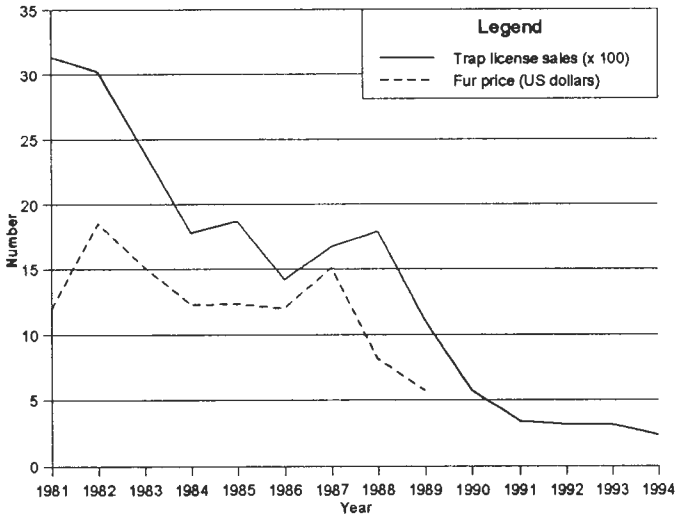
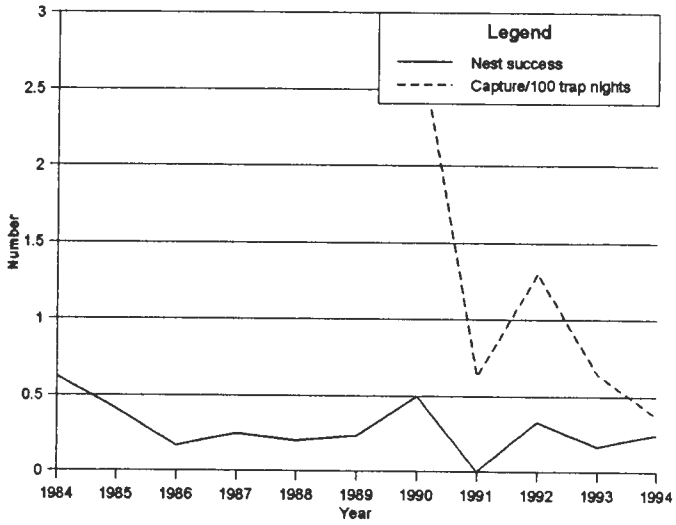
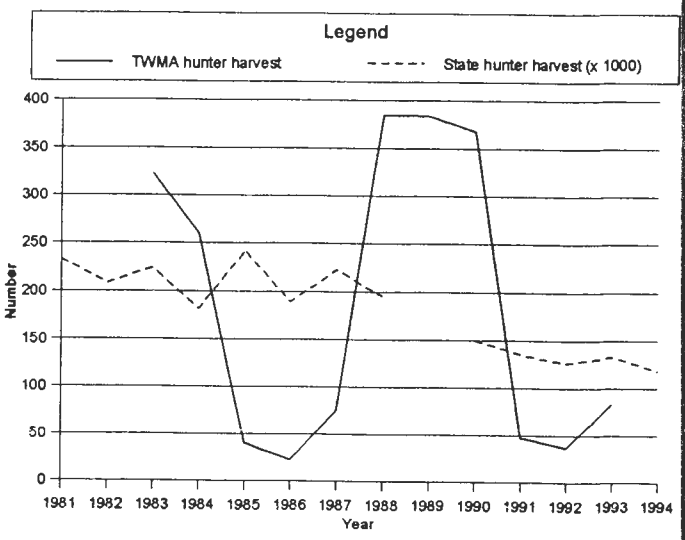
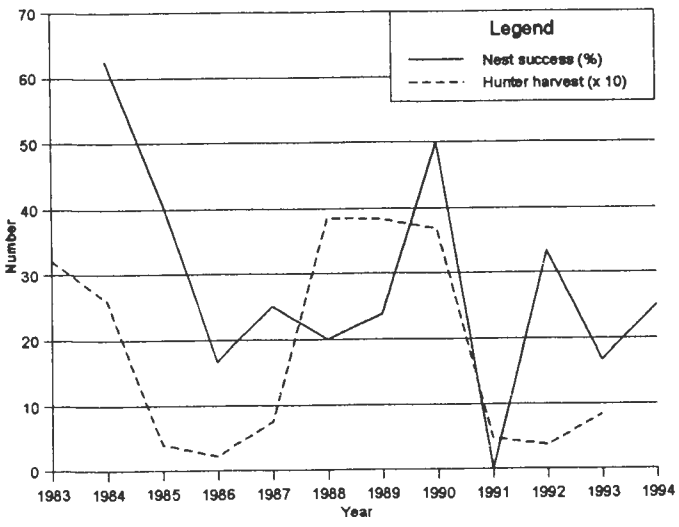
Hunter harvest
Hunter man-days
Number
Year
1000
800
600
400
200
0
1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993


Legend
Trap license sales (x 100)
Fur price (US dollars)
Number
Year
35
30
25
20
15
10
5
0
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994


Legend
Nest success
Capture/100 trap nights
Number
Year
3
2.5
2
1.5
1
0.5
0
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994


Legend
TWMA hunter harvest
State hunter harvest (x 1000)
Number
Year
400
350
300
250
200
150
100
50
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994



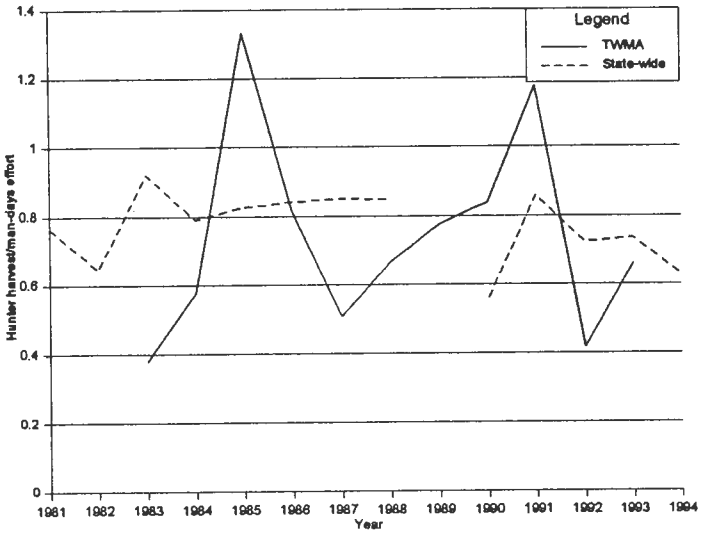


Figure 2. Raccoon harvest by trappers and trapping license sales in Mississippi, 1981-91 (a), raccoon harvest and man-days hunting raccoons by hunters state-wide in Mississippi, 1981-94 (1989 data unavailable) (b), raccoon harvest and man-days hunting raccoons by hunters on Tallahala Wildlife Management Area, Mississippi, 1983-93 (c), average raccoon fur price, 1981-89, and trapping license sales, 1981-94, in Mississippi (d), wild turkey hen nest success, 1984-94, and raccoon captures/100 trap nights, 1991-94 on Tallahala Wildlife Management Area, Mississippi (e), raccoon harvest by hunters state-wide, 1981-94 (1989 data unavailable), and on Tallahala Wildlife Management Area, 1983-93, Mississippi (f), wild turkey hen nest success, 1984-94, and raccoon hunter harvest/man-days effort, 1983-93, on Tallahala Wildlife Management Area, Mississippi (g), and raccoon hunter harvest/man-days effort state-wide, 1981-94 (1989 data unavailable), and on Tallahala Wildlife Management Area, 1983-93, Mississippi (h).